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1           1. A process for optimizing transmission speeds on a distributed  
2 transmission system which can support multiple upstream channels or logical  
3 channels simultaneously, comprising:

4                 1) gathering data about each cable modem (CM) in a group of CM  
5 coupled to a a cable modem termination system (CMTS) through a  
6 distributed transmission system;

7                 2) dividing said group of CMs up into logical groups based upon CM  
8 type and/or throughput ability;

9                 3) creating an upstream channel or logical channel on said distributed  
10 transmission system for each logical group of CMs, each upstream channel  
11 having transmission characteristics optimized for a particular logical group  
12 of modems; and

13                 4) assigning the modems in each logical group to the upstream  
14 channel created for that logical group.

1           2. The process of claim 1 further comprising the steps of monitoring the bit  
2 error rate of transmissions from each CM, and if the bit error rate of any CM  
3 becomes too high or too low relative to underperformance and overperformance  
4 standards, respectively, sending a message to said CM whose bit error rate has  
5 become too high or too low causing each said CM which is overperforming or  
6 underperforming to switch to an upstream channel with a burst profile which is  
7 compatible with the CM modem type and suitable for more efficient  
8 communications of digital data between said CMTS and said CM.

1           3. The process of claim 1 further comprising the steps of monitoring the  
2 byte error rate of transmissions from each CM, and if the byte error rate of any

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3 CM becomes too high or too low relative to underperformance and  
4 overperformance standards, respectively, sending a message to said CM whose  
5 byte error rate has become too high or too low causing each said CM which is  
6 overperforming or underperforming to switch to an upstream channel with a burst  
7 profile which is compatible with the CM modem type and suitable for more efficient  
8 communications of digital data between said CMTS and said CM.

1 4. The process of claim 1 further comprising the steps of monitoring the  
2 packet error rate of transmissions from each CM, and if the packet error rate of  
3 any CM becomes too high or too low relative to underperformance and  
4 overperformance standards, respectively, sending a message to said CM whose  
5 packet error rate has become too high or too low causing each said CM which is  
6 overperforming or underperforming to switch to an upstream channel with a burst  
7 profile which is compatible with the CM modem type and suitable for more efficient  
8 communications of digital data between said CMTS and said CM.

1 5. The process of claim 1 further comprising the steps of monitoring the  
2 signal-to-noise ratio (SNR) of transmissions from each CM, and if the SNR of any  
3 CM becomes too high or too low relative to underperformance and  
4 overperformance standards, respectively, sending a message to said CM whose  
5 SNR has become too high or too low causing each said CM which is  
6 overperforming or underperforming to switch to an upstream channel with a burst  
7 profile which is compatible with the CM modem type and suitable for more efficient  
8 communications of digital data between said CMTS and said CM.

1 6. The process of claim 1 further comprising the steps of monitoring the  
2 received power of transmissions from each CM, and if the received power of any

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3 CM at said CMTS becomes too high or too low relative to underperformance and  
4 overperformance standards, respectively, sending a message to said CM whose  
5 received power has become too high or too low causing each said CM which is  
6 overperforming or underperforming to switch to an upstream channel with a burst  
7 profile which is compatible with the CM modem type and suitable for more efficient  
8 communications of digital data between said CMTS and said CM.

1 7. The process of claim 1 wherein step 1 comprises gathering data about  
2 each modem's throughput ability by monitoring post registration upstream CM  
3 data transmissions and determining the value for one or more of a plurality of  
4 factors that indicate whether each said CM is overperforming or underperforming  
5 the burst profile and throughput ability of the upstream channel upon which said  
6 CM is transmitting, said factors including RS codeword error rate, SNR, received  
7 power, bit error rate, byte error rate and/or packet loss rate, and creating and  
8 directing said overperforming CMs to transmit upstream on one or more new  
9 upstream channels with burst profiles which are suitable for more efficient  
10 communication upstream by said overperforming CMs, and creating and directing  
11 said underperforming CMs to transmit upstream on one or more new upstream  
12 channels with burst profiles which are suitable for more efficient communication  
13 upstream by said underperforming CMs.

1 8. The process of claim 1 wherein step 1 comprises gathering data about  
2 each modem through a registration process and wherein step 2 comprises dividing  
3 modems into logical groups by modem type as learned from said registration  
4 process, and wherein step 1 further comprises gathering data about each  
5 modem's throughput ability by monitoring post registration data transmissions  
6 and determining the value for one or more of a plurality of factors that indicate

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7 whether said modem is overperforming or underperforming the burst profile and  
8 throughput ability of the upstream upon which said modem is transmitting, and  
9 wherein step 2 further comprising subdividing any logical group with one or more  
10 modems which are overperforming or underperforming into overperforming and  
11 underperforming logical subgroups, and wherein step 3 further comprises creating  
12 one or more upstream channels with burst profiles tailored to the throughput  
13 ability of said overperforming modems and wherein step 4 further comprises  
14 assigning said overperforming modems to an upstream channel with a burst  
15 profile tailored to the throughput ability of said overperforming modem(s), and  
16 wherein step 3 further comprises creating one or more upstream channels with  
17 burst profiles tailored to the throughput ability of said underperforming modems,  
18 and wherein step 4 further comprises assigning said underperforming modems to  
19 an upstream channel with a burst profile tailored to the throughput ability of said  
20 underperforming modem(s).

1 9. The process of claim 1 wherein step 1 comprises gathering data about  
2 each modem through a registration process and wherein step 2 comprises dividing  
3 modems into logical groups by modem type as learned from said registration  
4 process with DOCSIS 1.0 modems in one logical group and DOCSIS 1.1 modems in  
5 another logical group and DOCSIS 2.0 modems in a third logical group operating in  
6 SCDMA or ATDMA mode only, each logical group having created for it an  
7 upstream having a burst profile suited to the throughput ability and modulation  
8 profile of the modems in said logical group in step 3, and all modems in each  
9 logical group being assigned in step 4 to an upstream having a burst profile  
10 tailored to the modems in said logical group, and wherein step 1 further comprises  
11 gathering data about each modem's throughput ability by monitoring post  
12 registration data transmissions and determining the value for one or more of a

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13 plurality of factors that indicate whether said modem is overperforming or  
14 underperforming the burst profile and throughput ability of the upstream upon  
15 which said modem is transmitting, and wherein step 2 further comprising  
16 subdividing any logical group with one or more modems which are overperforming  
17 or underperforming into overperforming and underperforming logical subgroups,  
18 and wherein step 3 further comprises creating one or more upstream channels  
19 with burst profiles tailored to the throughput ability of said overperforming  
20 modems and wherein step 4 further comprises assigning said overperforming  
21 modems to an upstream channel with a burst profile tailored to the throughput  
22 ability of said overperforming modem(s), and wherein step 3 further comprises  
23 creating one or more upstream channels with burst profiles tailored to the  
24 throughput ability of said underperforming modems, and wherein step 4 further  
25 comprises assigning said underperforming modems to an upstream channel with a  
26 burst profile tailored to the throughput ability of said underperforming modem(s).

1        10. The process of claim 1 wherein step 1 comprises gathering data about  
2 each modem through a registration process and wherein step 2 comprises dividing  
3 modems into logical groups by modem type as learned from said registration  
4 process with DOCSIS 1.0 modems in one logical group and DOCSIS 1.1 modems in  
5 another logical group and DOCSIS 2.0 modems grouped into a logical group  
6 operating in SCDMA mode only and/or a logical group operating in ATDMA mode  
7 only, each logical group having created for it an upstream channel having a burst  
8 profile suited to the throughput ability and modulation profile of the modems in  
9 said logical group in step 3, and all modems in each logical group being assigned in  
10 step 4 to an upstream having a burst profile tailored to the modems in said logical  
11 group, and wherein step 1 further comprises gathering data about each modem's  
12 throughput ability by monitoring post registration data transmissions and

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13 determining the value for one or more of a plurality of factors that indicate  
14 whether said modem is overperforming or underperforming the burst profile and  
15 throughput ability of the upstream channel upon which said modem is transmitting,  
16 and wherein step 2 further comprising subdividing any logical group with one or  
17 more modems which are overperforming or underperforming into overperforming  
18 and underperforming logical subgroups, and wherein step 3 further comprises  
19 creating one or more upstream channels with burst profiles tailored to the  
20 throughput ability of said overperforming modems and wherein step 4 further  
21 comprises assigning said overperforming modems to an upstream channel with a  
22 burst profile tailored to the throughput ability of said overperforming modem(s),  
23 and wherein step 3 further comprises creating one or more upstream channels  
24 with burst profiles tailored to the throughput ability of said underperforming  
25 modems, and wherein step 4 further comprises assigning said underperforming  
26 modems to an upstream channel with a burst profile tailored to the throughput  
27 ability of said underperforming modem(s).

1 11. The process of claim 1  
2 wherein step 1 comprises gathering data about each modem through  
3 an initial ranging process and a registration process,  
4 and wherein step 2 comprises dividing modems into logical groups by  
5 modem type as learned from said registration process with DOCSIS 1.0  
6 modems in one logical group and DOCSIS 1.1 modems in another logical  
7 group and DOCSIS 2.0 modems in a third logical group operating in SCDMA  
8 mode only or ATDMA mode only,  
9 and wherein each logical group has created for it an upstream having  
10 a burst profile suited to the throughput ability and modulation profile of the  
11 modems in said logical group in step 3,

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12           and wherein all modems in each logical group being assigned in step 4  
13           to an upstream channel having a burst profile tailored to the modems in  
14           said logical group,

15           and wherein step 1 further comprises gathering data about the  
16           received signal power and/or signal-to-noise ratio (SNR) of initial ranging  
17           transmissions, and if any modem has inadequate received signal power  
18           and/or signal to noise ratio after a plurality of attempts to correct the  
19           problem, dividing said modems into one or more low power and/or high  
20           power subgroups and/or one or more low SNR and/or high SNR subgroups  
21           in step 2 and creating one or more lower throughput, more robust  
22           upstream channels for each low power and/or low SNR subgroup in step 3  
23           and sending messages to said modems that have low power and/or low  
24           SNR directing said modems to switch to said one or more lower  
25           throughput, more robust upstream channels, each lower throughput, more  
26           robust upstream channel having a burst profile tailored to achieve reliable  
27           communications with said modems in said low power and/or low SNR  
28           subgroup assigned to said lower throughput, more robust upstream  
29           channel such that registration can be completed, and creating one or more  
30           higher throughput, less robust upstream channels for each high power  
31           and/or high SNR subgroup in step 3 and sending messages to said modems  
32           that have high power and/or high SNR directing said modems to switch to  
33           said one or more higher throughput, less robust upstream channels, each  
34           higher throughput, less robust upstream channel having a burst profile  
35           tailored to achieve reliable communications with said modems in said high  
36           power and/or high SNR subgroup assigned to said higher throughput, less  
37           robust upstream channel such that registration can be completed;

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38                   and wherein step 1 further comprises gathering data about each  
39                   modem's throughput ability by monitoring post registration data  
40                   transmissions and determining the value for one or more of a plurality of  
41                   factors that indicate whether said modem is overperforming or  
42                   underperforming the burst profile and throughput ability of the upstream  
43                   upon which said modem is transmitting,

44                   and wherein step 2 further comprising subdividing any logical group  
45                   with one or more modems which are overperforming or underperforming  
46                   into overperforming and underperforming logical subgroups,

47                   and wherein step 3 further comprises creating one or more upstream  
48                   channels with burst profiles tailored to the throughput ability of said  
49                   overperforming modems,

50                   and wherein step 4 further comprises assigning said overperforming  
51                   modems to an upstream channel with a burst profile tailored to the  
52                   throughput ability of said overperforming modem(s),

53                   and wherein step 3 further comprises creating one or more upstream  
54                   channels with burst profiles tailored to the throughput ability of said  
55                   underperforming modems,

56                   and wherein step 4 further comprises assigning said underperforming  
57                   modems to an upstream channel with a burst profile tailored to the  
58                   throughput ability of said underperforming modem(s).

1                   12. The process of claim 11 further comprising the step of continuing to  
2                   monitor post registration data communications and determining the values of one  
3                   or more factors that indicate whether a modem is overperforming or  
4                   underperforming, and if any modem is overperforming or underperforming its  
5                   upstream channel's throughput ability, creating a new logical subgroup and new



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6 upstream channel for said modem and assigning said modem to transmit on said  
7 new upstream channel, said new upstream channel having a burst profile tailored  
8 to make efficient use of the throughput ability of said modem.

1 13. A process for optimizing transmission speeds on a distributed  
2 transmission system which can support multiple upstream channels simultaneously  
3 and which has a plurality of cable modems coupled to said distributed system,  
4 each having different upstream transmission modes, comprising:

5 transmitting one or more DOCSIS downstreams from a cable modem  
6 termination system (CMTS);

7 for each DOCSIS downstream, transmitting:

8 an upstream channel descriptor message which  
9 establishes a DOCSIS 1.0 upstream;

10 an upstream channel descriptor message which  
11 establishes a DOCSIS 2.0 SCDMA or DOCSIS 2.0 ATDMA  
12 upstream;

13 receiving initial ranging bursts from each of a plurality of cable  
14 modems (CM) and processing said bursts to conduct initial training of each  
15 CM which transmitted an initial ranging burst, and sending downstream  
16 messages to each CM to cause any needed adjustments in power,  
17 frequency, timing and/or equalization coefficients;

18 receiving registration transmissions from each CM which has  
19 successfully completed initial ranging, and determining the type of each CM  
20 from registration data;

21 creating a separate logical group for all DOCSIS 1.1 CMs and one or  
22 more separate 1.1 upstream channels for said DOCSIS 1.1 cable modems,  
23 each said 1.1 upstream channel having a burst profile tailored for the

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24 throughput ability of DOCSIS 1.1 CMs and linked to a downstream to which  
25 a DOCSIS 1.1 CM is tuned, and sending downstream messages to each  
26 DOCSIS 1.1 CM causing each DOCSIS 1.1 CM to switch to an 1.1 upstream  
27 channel linked to the downstream to which said CM is tuned.

1 14. The process of claim 13 further comprising the steps of monitoring the  
2 received power of each CM during initial training thereof, and, for any CM which has  
3 inadequate received power after a plurality of attempts to adjust transmit power  
4 of said CM have failed to cause said CM's signal to arrive at said CMTS with  
5 adequate received power, causing said CM to switch to an upstream channel with  
6 a burst profile which is compatible with the CM modem type and suitable for  
7 adequate communications of digital data between said CMTS and CM despite said  
8 power shortfall problem.

1 15. The process of claim 13 further comprising the steps of monitoring the  
2 received power of each cable modem in each logical group during initial training,  
3 and, if the received power from a CM is not adequate after a predetermined  
4 number of tries to adjust the transmit power of said CM, then concluding said CM  
5 has a power shortfall problem and either creating a low power, more robust  
6 upstream channel with a burst profile suitable to allow adequately reliable  
7 reception from said CM with said power shortfall problem and sending a message  
8 to said CM with said power shortfall problem so as to cause said CM with said  
9 power shortfall problem to switch to said low power, more robust upstream  
10 channel, or sending a message to said CM with said power shortfall problem so as  
11 to cause it to switch to a low power, more robust upstream channel which already  
12 exists and which is compatible with the type of DOCSIS modem said CM with said

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13 power shortfall problem is and which is linked to a downstream to which said CM  
14 with said power shortfall problem is tuned.

1 16. The process of claim 13 further comprising the steps of monitoring the  
2 signal to noise ratio of transmissions from each CM during initial training of said  
3 CM, and if the signal to noise ratio of any CM is still unacceptable after multiple  
4 attempts to complete initial training, sending a message to said CM whose signal  
5 to noise ratio has become unacceptable causing said CM to switch to an upstream  
6 channel with a burst profile which is compatible with the CM modem type and  
7 suitable for adequate communications of digital data between said CMTS and CM  
8 despite said inadequate signal to noise ratio problem.

1 17. A process for optimizing transmission speeds on a distributed  
2 transmission system which can support multiple upstream channels simultaneously  
3 and which has a plurality of cable modems coupled to said distributed system,  
4 each having different upstream transmission modes, comprising:  
5 transmitting one or more DOCSIS downstreams from a cable modem  
6 termination system (CMTS);  
7 for each DOCSIS downstream, transmitting:  
8 an upstream channel descriptor message which  
9 establishes a DOCSIS 1.0 upstream;  
10 an upstream channel descriptor message which  
11 establishes a DOCSIS 1.1 upstream;  
12 an upstream channel descriptor message which  
13 establishes a DOCSIS 2.0 upstream operating in SCDMA or  
14 TDMA mode;

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15 receiving initial ranging bursts from each of a plurality of cable  
16 modems (CM) and processing said bursts and sending downstream  
17 messages to each CM to cause any needed adjustments in power,  
18 frequency, timing and/or equalization coefficients;

19 receiving registration transmissions from each CM which has  
20 successfully completed initial ranging, and determining the type of each CM  
21 from registration data and sending any necessary downstream messages  
22 to any CM that is transmitting on an upstream not having a burst profile  
23 optimized for the modulation profile of said CM causing said CM to move to  
24 an upstream having a burst profile optimized for the CM's modulation  
25 profile;

26 monitoring the received power of each CM during initial training  
27 thereof, and determining any CM which has inadequate received power or  
28 inadequate signal-to-noise ratio after a plurality of attempts to adjust  
29 transmit power of said CM have failed to cause said CM's signal to arrive at  
30 said CMTS with adequate received power or adequate signal to noise ratio;

31 sending a downstream message to each CM which has inadequate  
32 received signal power or signal-to-noise ratio to cause said CM to switch to  
33 a lower throughput upstream channel with a burst profile which is  
34 compatible with the CM type and suitable for adequate communications of  
35 digital data between said CMTS and CM despite inadequate received signal  
36 power or inadequate signal-to-noise ratio.

1 18. The process of claim 17 further comprises the steps of gathering data  
2 about each modem's throughput ability by monitoring post registration data  
3 transmissions and determining the value for one or more of a plurality of factors  
4 that indicate whether said modem is overperforming or underperforming the burst

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5 profile and throughput ability of the upstream upon which said modem is  
6 transmitting, and further comprising the step of subdividing any logical group with  
7 one or more modems which are overperforming or underperforming into  
8 overperforming and underperforming logical subgroups, and further comprising the  
9 step of creating one or more upstream channels with burst profiles tailored to the  
10 throughput ability of said overperforming modems, and further comprising the  
11 step of assigning said overperforming modems to an upstream channel with a  
12 burst profile tailored to the throughput ability of said overperforming modem(s),  
13 and further comprising the step of creating one or more upstream channels with  
14 burst profiles tailored to the throughput ability of said underperforming modems,  
15 and further comprising the step of assigning said underperforming modems to an  
16 upstream channel with a burst profile tailored to the throughput ability of said  
17 underperforming modem(s).

18  
1 19. A process for optimizing transmission speeds on a distributed  
2 transmission system which can support multiple upstream channels simultaneously  
3 and which has a plurality of cable modems coupled to said distributed system,  
4 each having different upstream transmission modes, comprising:

5 transmitting one or more DOCSIS downstreams from a cable modem  
6 termination system (CMTS);

7 for each DOCSIS downstream, transmitting:

8 an upstream channel descriptor message which  
9 establishes a DOCSIS 1.0 upstream;

10 an upstream channel descriptor message which  
11 establishes a DOCSIS 2.0 upstream;

12 receiving initial training bursts from each of a plurality of cable  
13 modems (CM) and deducing the cable modem type from the upstream upon

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14 which each said initial training burst was received thereby creating defacto  
15 logical groups of cable modems grouped by modem type.  
16 receiving registration communications from each CM;  
17 after registration, receiving upstream data transmissions from each  
18 CM;  
19 monitoring one or more of the following parameters of  
20 communication of data from each CM: the received power; the signal to  
21 noise ratio; the bit error rate; the byte error rate; the Reed-Solomon  
22 codeword error rate; and the packet error rate;  
23 if performance of any CM becomes either too good or too bad, as  
24 measured by comparing the monitored parameter for said CM to limits that  
25 establish what performance level is too good or too bad, sending a  
26 message to said CM to cause it to change to an upstream channel which  
27 has a burst profile which is suitable for the CM's performance.

1 20. An apparatus comprising:  
2 any DOCSIS compatible cable modem termination system having a  
3 control computer programmed to carry out a process comprising the  
4 steps:  
5 receiving in a cable modem termination system (CMTS) registration  
6 messages from each cable modem coupled to said CMTS and determining  
7 the modem type from each registration message;  
8 in said cable modem termination system assigning each cable modem  
9 to a group based upon the modem type with DOCSIS 1.0 compliant  
10 modems in a first group, DOCSIS 1.1 compliant modems in a second group,  
11 DOCSIS 2.0 compliant modems in a third group;

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12           in said cable modem termination system, generating and transmitting  
13           downstream to all said cable modems a plurality of Upstream Channel  
14           Descriptor (UCD) messages, each UCD message establishing a logical  
15           upstream channel to which one of the groups of modems will be assigned  
16           and defining a burst profile for said logical upstream channel which is  
17           appropriate for the group of modems that will be assigned to transmit on  
18           that upstream logical channel;  
19           generating in said cable modem termination system and transmitting  
20           to each said cable modem which has registered a message which tells each  
21           cable modem the upstream logical channel to which it has been assigned.

1           21. The apparatus of claim 20 wherein said control computer is further  
2           programmed to carry out the steps of:  
3                 1) monitoring the received power from each cable modem in a group;  
4                 2) if the received power at said CMTS is less than a required value  
5                 for a cable modem, commanding said cable modem to increase its transmit  
6                 power in a downstream message and repeating steps 1 and 2 until said  
7                 cable modem's transmitted signal arrives at said CMTS at the required  
8                 power;  
9                 3) if after reaching its maximum power available, a cable modem's  
10                upstream transmissions still do not arrive at said CMTS at the required  
11                power level, subdividing said cable modem into a subgroup comprised of all  
12                modems of the same type and whose signals do not arrive at said CMTS at  
13                the required power level despite each said modem in said subgroup  
14                transmitting at the maximum available power;  
15                4) generating a UCD message for a new logical upstream to which  
16                said modems in said subgroup will be assigned, said UCD message

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17 establishing a burst profile for said new logical upstream which is sufficiently  
18 robust in its forward error correction, modulation type, symbol rate and/or  
19 other burst parameters such that modems in said subgroup can transmit  
20 upstream with an acceptable error rate.

1 22. The apparatus of claim 20 wherein said control computer is further  
2 programmed to carry out the steps of:

3 monitoring the received power of each CM during initial training  
4 thereof, and, for any CM which has inadequate received power after a  
5 plurality of attempts to adjust transmit power of said CM have failed to  
6 cause said CM's signal to arrive at said CMTS with adequate received  
7 power, causing said CM to switch to an upstream channel with a burst  
8 profile which is compatible with the CM modem type and suitable for  
9 adequate communications of digital data between said CMTS and CM  
10 despite said power shortfall problem.

1 23. The apparatus of claim 20 wherein said control computer is further  
2 programmed to carry out the steps of:

3 monitoring one or more of the following parameters of  
4 communication of data from each CM: the received power; the signal to  
5 noise ratio; the bit error rate; the byte error rate; the Reed-Solomon  
6 codeword error rate; and the packet error rate;

7 if performance of any CM becomes either too good or too bad, as  
8 measured by comparing the monitored parameter for said CM to limits that  
9 establish what performance level is too good or too bad, sending a  
10 message to said CM to cause it to change to an upstream channel which  
11 has a burst profile which is suitable for the CM's performance, and creating



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12           an new upstream channel with suitable burst profile if necessary to which  
13           said CM whose performance is too good or too bad may be changed.

1           24. The apparatus of claim 20 wherein said CMTS has line cards which  
2           receive upstream signals from upstreams on a plurality of data paths from  
3           different cable nodes, and wherein said line cards have switches therein controlled  
4           by said CMTS to gate bursts from said plurality of data paths to a controller, and  
5           wherein control computer is further programmed to control said switch of any line  
6           card coupled to a cable upon which a TDMA burst is expected to turn on during a  
7           gap before said TDMA burst and turn off during a gap after said TDMA burst and  
8           to keep all other switches of other line cards turned off such that only said  
9           expected burst is gated through to said combiner, and wherein said control  
10          computer is further programmed to control the switch of any line card coupled to  
11          a cable upon which an SCDMA burst is expected to turn on during the ramp up of  
12          said SCDMA burst and to turn off during a ramp down of said SCDMA burst and  
13          to control other switches of other line cards to behave in the same way for  
14          expected SCDMA bursts on cables coupled to said other line cards.